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ETSI STANDARD

Environmental Engineering (EE); Monitoring and control interface for infrastructure equipment (power, cooling and building environment systems used in telecommunication networks); Part 12: ICT equipment power, energy and environmental parameters monitoring information model

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Foreword

This final draft ETSI Standard (ES) has been produced by ETSI Technical Committee Environmental Engineering (EE), and is now submitted for the ETSI Membership Approval Procedure (MAP).

The present document is part 12 of a multi-part deliverable covering monitoring and control interface for infrastructure equipment (power, cooling and building environment systems used in telecommunication networks), as identified below:

Part 1: "Generic Interface";

Part 2: "DC power system control and monitoring information model";

Part 3: "AC UPS power system control and monitoring information model";

Part 4: "AC distribution power system control and monitoring information model";

Part 5: "AC diesel back-up generator system control and monitoring information model";

Part 6: "Air Conditioning System control and monitoring information model";

Part 7: "Other utilities system control and monitoring information model";

Part 8: "Remote Power Feeding System control and monitoring information model";

Part 9: "Alternative Power Systems";

Part 10: "AC inverter power system control and monitoring information model";

Part 11: "Battery system with integrated control and monitoring information model";

Part 12: "ICT equipment power, energy and environmental parameters monitoring information model".

Executive summary

The goal of the present document is to define the measurement of electrical power and energy consumption of ICT equipment as well as environmental parameters (temperature, hygrometry) in order to improve energy monitoring and to correlate the power consumption to equipment operation activity (telecom traffic, computation, etc.). It is also to define the transfer protocol of this measurement data from site to network operation centre. Understanding power consumption provides the opportunity to reduce energy consumption of equipment and/or the network. Granularity, measurement period and accuracies are defined to meet these targets. They may depend on equipment types and location in the different segments of a network (customer termination, access, core, data-centre, etc.). In addition, these measurements can be used to improve engineering and operation including more accurate dimensioning of power systems, network evolution modelling and prevision, audit on field, etc.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

The present document was developed jointly by ETSI TC EE and ITU-T Study Group 5. It is published respectively by ITU and ETSI as Recommendation ITU-T L.1396 [i.2] and ETSI ES 202 336-12 [i.16] (the present document), which are technically-equivalent.

1 Scope

The present document defines measurement and monitoring of power, energy and environmental parameters for ICT equipment in telecommunications or data centre or customer premises.

It defines the power, energy and environmental parameters monitoring interface of ICT equipment based on generic ETSI ES 202 336-1 [1] interface so that correlations can be made with ICT equipment parameters (traffic, flowrate, number of connected lines, radio setting, QoS KPI, etc.) in the Network Management System (NMS).

Correlations of monitored data (power, energy consumption and environmental values) with other ICT equipment functional parameters and settings are not in the scope of the present document.

The monitoring interface covers:

- Internal power consumption measurement on the ICT equipment powered in DC and AC.
- Power consumption measurement external to the ICT equipment (if not implemented internally, e.g. legacy equipment).
- Energy metering based on power consumption measurement.
- Environmental parameters of the ICT equipment (e.g. temperature at air inlet of equipment).

The present document defines:

- The minimum set of exchanged information required at the interface, including parameters such as measurement type (e.g. RMS), accuracy, range, etc. and settings such as data acquisition and transmission period, etc. This includes the data preparation, recording and transmission functions.
- The testing method of some parameters and functions.

Text tables in annexes A and B with data exchange described in "natural language".

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found in the ETSI docbox.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long-term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI ES 202 336-1: "Environmental Engineering (EE); Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks); Part 1: Generic Interface".

[2] ETSI ETS 300 132-1: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 1: Operated by alternating current (ac) derived from direct current (dc) sources".

[3] ETSI ES 202 336-2: "Environmental Engineering (EE); Monitoring and control interface for infrastructure equipment (Power, Cooling and environment systems used in telecommunication networks); Part 2: DC power system control and monitoring information model".

[4] ETSI ES 202 336-3: "Environmental Engineering (EE); Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks); Part 3: AC UPS power system control and monitoring information model".

[5] ETSI ES 202 336-10: "Environmental Engineering (EE); Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks); Part 10: AC inverter power system control and monitoring information model".

[6] ETSI EN 300 132-2: "Environmental Engineering (EE); Power supply interface at the input of Information and Communication Technology (ICT) equipment; Part 2: -48 V Direct Current (DC)".

[7] ETSI ES 202 336-4: "Environmental Engineering (EE); Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks); Part 4: AC distribution power system control and monitoring information model".

[8] ETSI ES 202 336-6: "Environmental Engineering (EE); Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks); Part 6: Air Conditioning System control and monitoring information model".

[9] ETSI EN 300 119-5: "Environmental Engineering (EE); European telecommunication standard for equipment practice; Part 5: Thermal management".

[10] Recommendation ITU-T L.1395 (2025): "Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks); Generic Interface".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents may be useful in implementing an ETSI deliverable or add to the reader's understanding, but are not required for conformance to the present document.

[i.1] IEEE 802.1™ to 802.11™: "IEEE Standard for Local & Metropolitan Area Network".

[i.2] Recommendation ITU-T L.1396: "Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks) - ICT equipment power, energy and environmental parameters monitoring information model".

[i.3] ETSI ES 203 215: "Environmental Engineering (EE); Measurement Methods and Limits for Power Consumption in Broadband Telecommunication Networks Equipment".

[i.4] ETSI ES 202 706: "Environmental Engineering (EE); Measurement method for power consumption and energy efficiency of wireless access network equipment".

NOTE: ETSI ES 202 706 is a revision of ETSI TS 102 706.

[i.5] ETSI ES 201 554: "Environmental Engineering (EE); Measurement method for Energy efficiency of Mobile Core network and Radio Access Control equipment".

[i.6] ETSI ES 203 184: "Environmental Engineering (EE); Measurement Methods for Power Consumption in Transport Telecommunication Networks Equipment".

[i.7] ETSI ES 203 136: "Environmental Engineering (EE); Measurement methods for energy efficiency of router and switch equipment".

[i.8] ETSI EN 301 575: "Environmental Engineering (EE); Measurement method for energy consumption of Customer Premises Equipment (CPE)".

[i.9] ETSI ES 203 237: "Environmental Engineering (EE); Green Abstraction Layer (GAL); Power management capabilities of the future energy telecommunication fixed network nodes".

[i.10] ETSI ES 203 228: "Environmental Engineering (EE); Assessment of Mobile Network Energy Efficiency".

[i.11] Recommendation ITU-T M.3000 series: "TMN and network maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits Telecommunications management network".

[i.12] Recommendation ITU-T M.3010 series: "TMN and network maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits Telecommunications management network - Principles for a telecommunications management network".

[i.13] ETSI TS 132 101 (V15.0.0) (09-2018): "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Telecommunication management; Principles and high level requirements (3GPP TS 32.101 version 15.0.0 Release 15)".

[i.14] ETSI EN 302 099: "Environmental Engineering (EE); Powering of equipment in access network".

[i.15] ETSI EN 300 132-3: "Environmental Engineering (EE); Power supply interface at the input of Information and Communication Technology (ICT) equipment; Part 3: Up to 400 V Direct Current (DC)".

[i.16] ETSI ES 202 336 (all parts): "Environmental Engineering (EE); Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks)".

[i.17] ETSI TS 128 532 (2024): "5G; Management and orchestration; Generic management services (3GPP TS 28.532 version 18.2.0 Release 18)".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

NOTE: Terms referring to energy interface, equipment and distribution are described in power distribution standards ETSI ETS 300 132-1 [2], ETSI EN 300 132-3 [i.15], ETSI EN 300 132-2 [6] for ac and dc interface A and A3 and ETSI EN 302 099 [i.14] for access network equipment powering.

AC distribution power system: device or system that distribute AC voltage or convert DC voltage to AC voltage and provides electrical power without interruption in the event that commercial power drops to an unacceptable voltage level

alarm: any information signalling abnormal state, i.e. different to specified normal state of hardware, software, environment condition (temperature, humidity, etc.)

NOTE 1: As defined in ETSI ES 202 336-1 [1].

NOTE 2: The alarm signal should be understood by itself by an operator and should always have at least one severity qualification or codification (colour, level, etc.). Alarm message structure is defined in ETSI ES 202 336-1 [1].

EXAMPLE: Rectifier failure, battery low voltage, etc.

board: electronic part of an equipment (e.g. a blade server)

cabinet: closed enclosure including several shelves or sub-racks

Control Unit (CU): integrated unit in an equipment to monitor and control this equipment through sensors and actuators

NOTE: As defined in ETSI ES 202 336-1 [1].

customer premises: any location which is the sole responsibility of the customer

Data Gathering Unit (DGU): functional unit used for several functions:

- collect serial, digital, and analogue data from several equipment;
- option to send (output) serial or digital commands;
- forward/receive information to/from the Local/Remote Management Application via agreed protocols;
- mediation between interfaces and protocols.

NOTE 1: This function may be integrated as part of specific equipment.

NOTE 2: As defined in ETSI ES 202 336-1 [1].

DC back-up system: device or system that provides electrical power without interruption in the event that commercial power drops to an unacceptable voltage level

DC distribution power system: device or system to distribute DC voltage

Downstream: point of measure of electric parameter identified after the input of power to the equipment

ethernet: LAN protocol

NOTE: Equivalent to IEEE 802.1 to 802.11 [i.1].

event: any information signalling a change of state which is not an alarm: e.g. battery test, change of state of battery charge

NOTE 1: As defined in ETSI ES 202 336-1 [1].

NOTE 2: The event signal should be understood by itself by an operator It should be transmitted in a formatted structure with text message and other fields like for alarm. An event can be coded as an alarm with severity "0".

ICT site room: close location where ICT equipment is installed where it is considered that environmental conditions are stable

infrastructure equipment: power, cooling and building environment systems used in telecommunications centres and Access Networks locations

NOTE: As defined in ETSI ES 202 336-1 [1].

EXAMPLE: Cabinets, shelters, underground locations, etc.

module: closed unit including electronic boards forming part of a larger system (e.g. sub-unit of a base station in a cabinet or separated)

rack: sub part of the cabinet including ICT equipment

shelf: level in a cabinet

Type 1 measurement: built-in measurements inside ICT equipment downstream from interface A (or A3)

Type 2 measurement: external measurement at input junction box measurements upstream from interface A (or A3)

Type 3 measurement: power frame measurement at output of power supply system

upstream: point of measure of electric parameter is identified before the input of power to the equipment

warning: low severity alarm

NOTE: As defined in ETSI ES 202 336-1 [1].

xDSL: global designation of the Digital Subscriber Line (DSL) technologies

3.2 Symbols

For the purposes of the present document, the following symbols apply:

C	Capacitor
E	Electric energy
I	Electric current
f	Frequency
P	Electric power
R	Resistance
RC	Time constant of a timer circuit
T	Temperature
U	Electric voltage or difference of potential
T_{acq}	Voltage and Current acquisition period
T_{rec}	PEE record time period for remote transmission
T_{rms}	RMS integration period
T_{trans}	Transmission period of data records

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AC	Alternating Current
ADSL	Asynchronous Digital Subscriber Line
BB	Broad-Band
BBU	Base-Band Unit
BS	Base Station
CPE	Customer Premises Equipment
CU	Control Unit of an equipment
DC	Direct Current
DGU	Data Gathering Unit
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
EMS	Energy Management System
E-UTRAN	Extended UTRAN
FAN	Fixed Access Network
GAL	Green Abstraction Layer
ICT	Information and Communication Technology
IP	Internet Protocol
KPI	Key Performance Indicator
LAN	Local Array Network
MSAN	MultiService Access Network
NE	Network Element
NMS	Network Management System
OLT	Optical Line Termination
ONT	Optical Network Termination
ONU	Optical Network Unit
OSS	Operations Support System
PEE	Power, Energy, Environmental parameters
PFC	Power Factor Correction
RMA	Remote Management Application

RMS	Remote Management Server
RMS	Root Mean Square
RRU	Remote Radio Unit
SBMA	Service Based Management Architecture
SMPS	Switched Mode Power Supply
TCP	Transmission Control Protocol for IP
TMN	Telecom Management Network

NOTE: As defined in Recommendation ITU-T M.3000 series [i.11].

UPS	Un-interruptible Power Supply
UTRAN	Extended Terrestrial Radio Access Network
VDC	Volt Direct Current
x DSL	x Digital Subscriber Line

NOTE: x stands for many different type of DSL such as: A (Asymmetric), H (high-data-rate), RA (Rate Adaptive), S (Symmetric digital subscriber line), V (Very high speed), SH (Single-pair High-speed), G.SH (first version of SDSL).

4 ICT power, energy and environmental parameters monitoring system

4.1 General description

The basic principles of power, energy and environment parameters measurements of ICT equipment (temperature, hygrometry) and their transfer to the Network Management Systems (NMS) are shown in figure 1.

NOTE 1: The definition of specific NMS for mobile or fixed networks is out of scope of the present document. The same comment applies to OSS.

The following measuring device are used:

- wattmeter or energy meter (W, Wh, kWh); and/or
- voltage meter (V); and/or
- current meter (A);
- thermometer;
- hygrometer.

Voltage or current shall be recorded for monitoring when used to assess the power and energy consumption. Temperature shall also be measured and recorded.

NOTE 2: The energy consumption can be calculated from power measurement over a period of time.

NOTE 3: Humidity should be measured at the level of ICT site room or air conditioning, not at equipment level, relative humidity.

In the preferred implementation, power and energy measurements shall be taken downstream of power supply interface A or A3 as defined in ETSI ETS 300 132-1 [2], ETSI EN 300 132-2 [6] and ETSI EN 300 132-3 [i.15] and inside the ICT equipment (type 1 measurement).

Otherwise e.g. on legacy equipment, power and energy measurements can be taken upstream of interface A outside the ICT equipment (type 2 measurement).

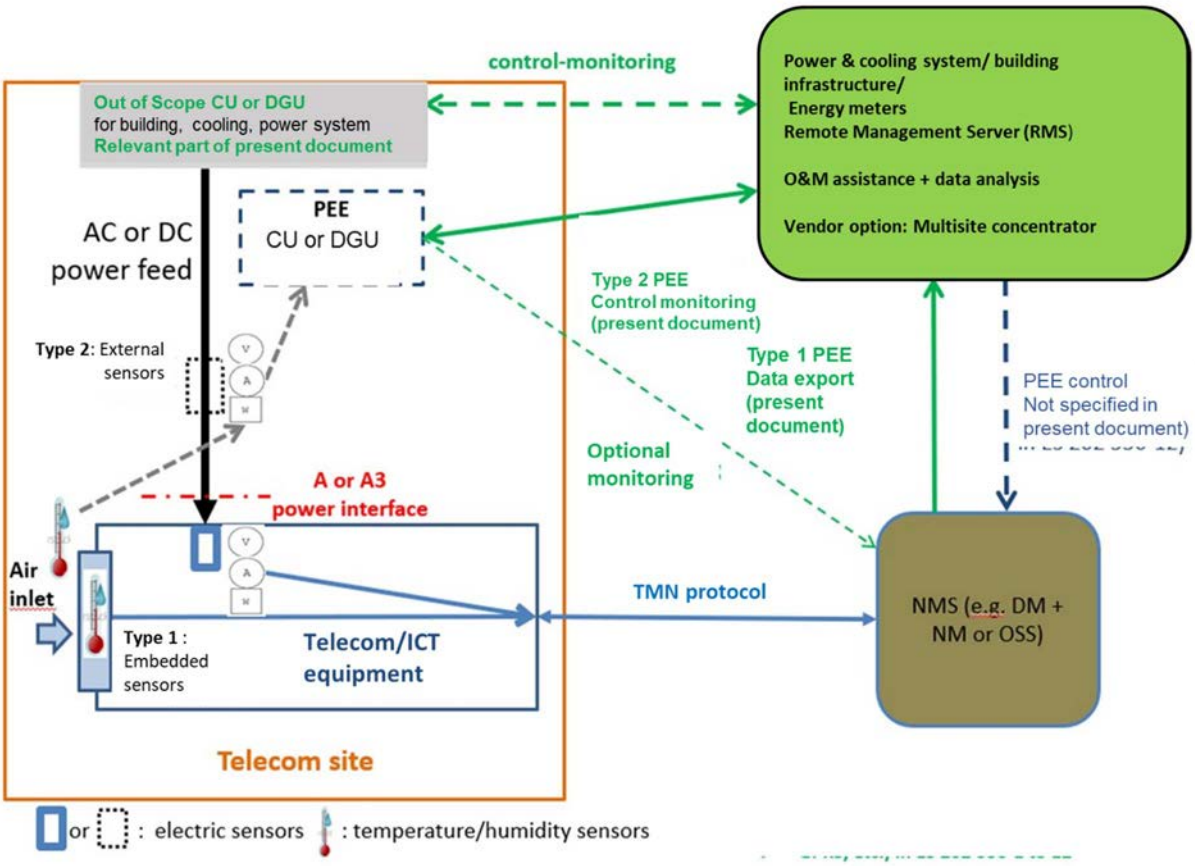
The electrical measurement sensors shall be located as close as possible to the power supply interface (A or A3) and the thermal environment sensors shall be placed in the air flow of the air inlet of the equipment, in case of equipment designed without air inlet the thermal environment sensor shall be placed in a way to measure the external temperature.

PEE measurement values can be transmitted directly from CU or DGU to RMS or indirectly by the NE through the TMN protocol over the NMS to the RMS. The direct and indirect transmission shall comply with ETSI ES 202 336-1 [1] and the present document's.

NOTE 4: The Network Management System (NMS) is the functional entity from which the network operator monitors and controls the system at centralized level and manage operational and maintenance activities. The operation and Maintenance functions are based on the principles of the Telecommunication Management Network (TMN) of Recommendation ITU-T M.3010 [i.12] introduced by Recommendation ITU-T M.3000 series [i.11].

NOTE 5: The measurements done using the present document can be used as inputs for enabling:

- the assessment of Power Consumption in Broadband Telecommunication Networks Equipment [i.3], Transport Telecommunication Networks Equipment [i.6] and Customer Premises Equipment (CPE) [i.8];
- the assessment of Energy efficiency of wireless access network equipment [i.4], Core network equipment [i.5], router and switch equipment [i.7] and Mobile Network ETSI ES 203 228 [i.10];
- the power management capabilities for telecommunication fixed network nodes with Green Abstraction Layer (GAL) as specified in [i.9].



NOTE 1: In figure 1, some ICT sites may not have all of the parts (building, power, cooling) and therefore monitoring interface would not be required.

NOTE 2: An ICT equipment of a vendor X is in general connected to the NMS of the vendor X, but the power/air conditioning /building infrastructure RMScan be from a vendor Y.

Figure 1: Principle of the monitoring of ICT equipment power, energy and environment parameters

4.2 Complementarity to existing site power and air-conditioning measurements

The Power/Energy and Environmental (PEE) parameters measurement on ICT equipment as standardized in the present document are complementary to the measurements defined at the site and room level on the power and air conditioning systems introduced in standard ETSI ES 202 336-1 [1].

In particular the standards ETSI ES 202 336-2 [3], ETSI ES 202 336-3 [4], ETSI ES 202 336-4 [7], ETSI ES 202 336-6 [8] and ETSI ES 202 336-10 [5] define PEE measurements monitored by non ICT equipment in telecommunications or data centre or customer premises (e.g. power, cooling and distributions systems):

- AC and DC current, voltage and or power sensors;
- AC and DC energy meters;
- Voltage, current, AC frequency measurement sensors;
- True Power factor measurement device;

NOTE 1: The true Power Factor includes the AC Displacement Factor (i.e. the cosine of the phase angle between AC current and voltage of 50 Hz fundamental signals) and the current Distortion Factor. The current distortion is the highest factor for ICT load powered by SMPS as phase angle is close to 0. The distortion factor is a measurement of the performance of the Power Factor Correction (PFC) function.

- Sensors bus e.g. for power metering;
- Additional measurements.

NOTE 2: For very critical site, there could be additional power quality monitoring measurements (e.g. harmonic currents amplitude, power factor, distortion, dips, etc.) as defined in ETSI ES 202 336-4 [7].

NOTE 3: All the PEE measurements transmitted through ETSI ES 202 336 [i.16] (all series) can be used to get measurements complementary to those defined in the present document e.g. DC current or power measurement compliant to ETSI ES 202 336-2 [3] at the output of a DC system supplying one or several ICT equipment.

4.3 Different site cases

4.3.1 Simple site case

Two types (see figure 2) of PEE monitoring can exist in a simple ICT site, and the compatibility is ensured between these types with the remote monitoring:

- Type 1: built-in measurements inside ICT equipment downstream from interface A (or A3).
- Type 2: external measurement at input junction box measurements upstream from interface A (or A3).

Internal power consumption and environment sensors and external measurement connected to an energy metering/environment CU shall be used as defined in clause 4.4. Humidity measurements are optional.

Data export from NMS to the power/cooling remote management server shall use ETSI ES 202 336-1 [1] and the present document. The NMS can also be used for dialog with other type of server as explained in clause 4.5.

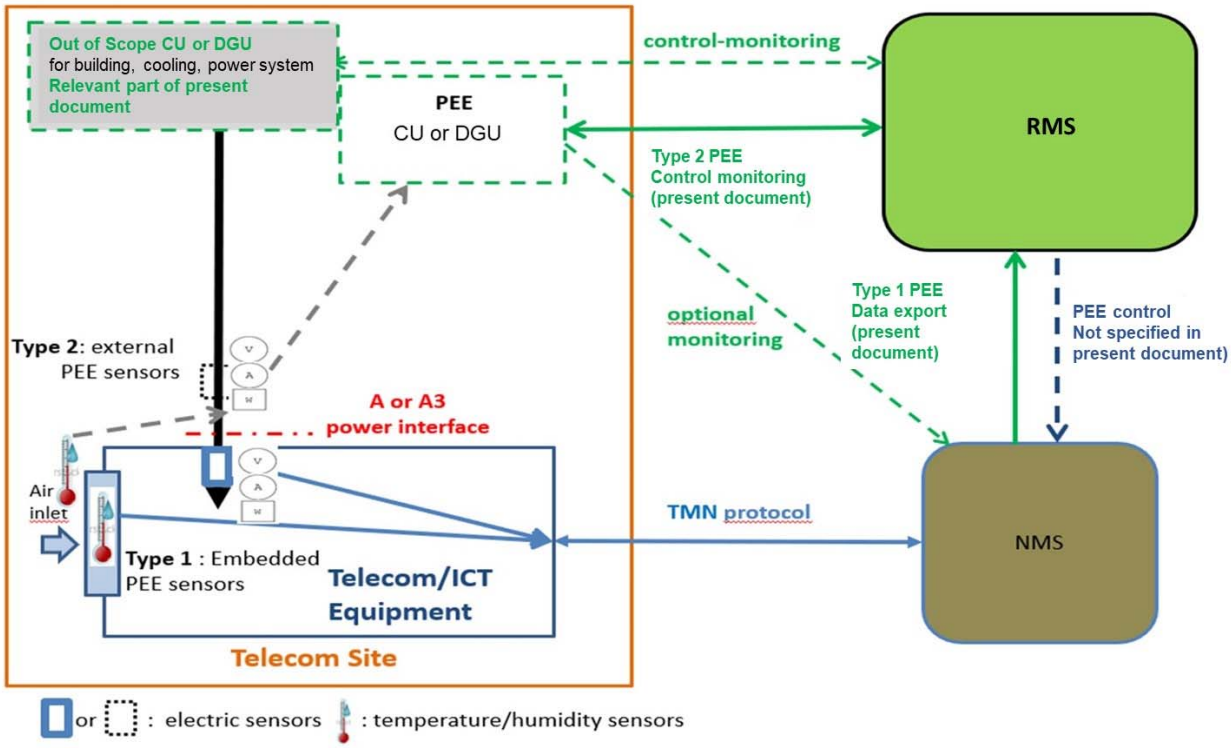


Figure 2: Example of possible implementation in a simple Telecom site (e.g. a radio mobile site with ICT/Telecom connected to an OSS/NMS)

4.3.2 Complex site case

Figure 3 gives example of 3 cases of monitoring of PEE measurement that can exists in a complex ICT site, and how compatibility is ensured between these cases with the remote monitoring:

- Type 1: built-in measurements inside ICT equipment downstream from interface A (or A3).
- Type 2: external measurement at input junction box measurements upstream from interface A (or A3).
- Type 3: power frame measurement at output of power supply system.

On complex big sites with many equipment from different manufacturers and of different types, operators require power and energy measurement of each ICT equipment and the global monitoring provided in power and air-conditioning is not sufficiently accurate.

For measurement on the power system and power distribution frame, the issue is to manage on the long run the cabling tracing and identification to be sure that the measurement always corresponds to the same considered ICT equipment. It often happens that a power output cable is common to several equipment, powered in room through a secondary distribution cabinet with smaller cables. With redundancy and double distribution from separate sources it is even more complicated. In addition, the distribution is changing with the evolutive life of the site.

For air condition, this can happen that the sensors are not located close enough to the ICT equipment so that the sensor does not reflect the condition really seen by the ICT equipment.

So, it seems much more reliable and stable to define the closest measurement as possible of the power input and of air inlet of the ICT equipment.

It is preferred to measure power inside the ICT equipment on the power input lines. If not possible it can be done outside but always downstream interface A or A3 as defined in ETSI ETS 300 132-1 [2], ETSI EN 300 132-2 [6] and ETSI EN 300 132-3 [i.15] of the considered ICT considered element under measurement.

When there are several power interface A or A3 inputs on the same ICT equipment, the sum of all power and energy measurements shall be provided in the monitored data in addition to individual values.

The temperature and humidity in which the ICT equipment is operating, shall be taken by an external sensor located at the air inlet of ICT equipment as defined in ETSI EN 300 119-5 [9], annex A. As in clause 4.3.1 for simple site, the data transmitted to the NMS shall be available on export line to another server as specified in clause 4.5.

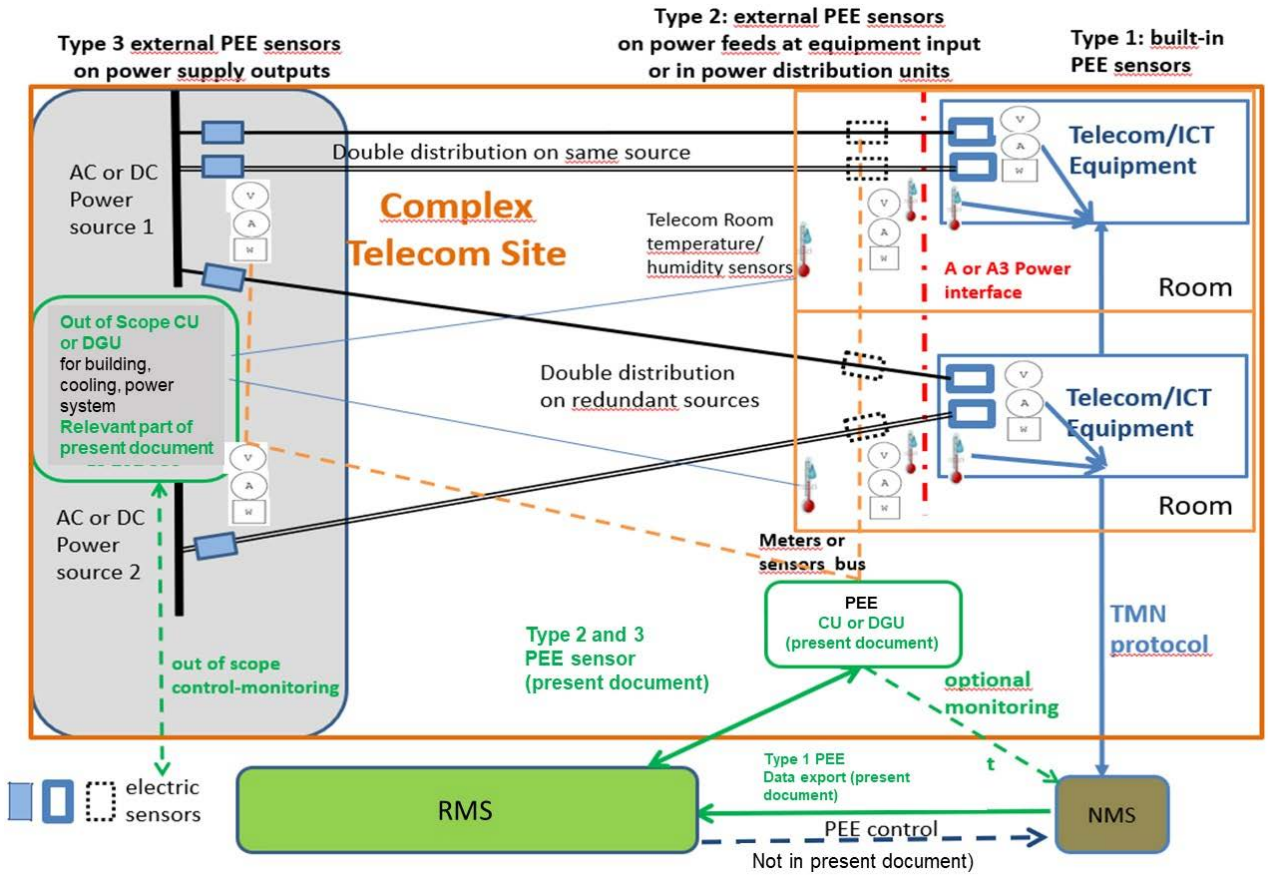


Figure 3: Example of cohabitation of ICT equipment internal and external power/energy/environment measurement acquisition in a site considering 3 cases of implementations (power frame measurement, input junction box measurements, built-in measurements)

4.4 Measurement and monitoring description

4.4.0 General description

This description of measurement is split in the 3 following clauses (clauses 4.4.1 to 4.4.3):

- downstream of interface A or A3 built-in measurement for new equipment (type 1);
- upstream of interface A or A3 measurement for legacy equipment (type 2);
- common requirements.

4.4.1 Internal measurements type 1 (Built-in in ICT equipment)

Power consumption measurements are done inside the ICT equipment.

The priority of measurement is on power inputs downstream of interface A of equipment, to be intended for the purpose of the present document as interface A at shelf level (both for deployment in a rack or in a cabinet enclosure).

Optionally measurement can be provided at board level.

In table 1, the power/energy/temperature measurement defined for each network element shall be applied.

PEE associated to NFV is included in the measurement performed in the relevant hardware, see table 1.

Table 1: Description of equipment covered by the present document

Equipment Type	Environment Type	Power interface	Equipment Identification
RRU, BBU, Wide area BS cabinet, medium range BS, in 2G, 3G, 4G, 5G	Indoor and outdoor	A or A3 (DC) or A1 (AC)	Equipment single identification code i.e. for BBU and RRU, etc.
OLT, ONU, MSAN, DSLAM (xDSL, MSAN, other FAN equipment) Fixed BB cabinet as a whole that can include the previous equipment (indoor or outdoor)	Indoor and outdoor	Mainly A or A3 (DC)	Single NE identification code i.e. for ONU, xDSL, etc.
Node, optical transmission equipment, etc. Each equipment at the shelf level for fixed network interface	Mainly indoor	A or A3 (DC)	
Optical transmission equipment, microwave link, etc.	Indoor and Outdoor	A or A3 (DC)	
Each equipment at shelf level in a rack	Mainly indoor	A or A3 (DC) or A1 (AC)	
Each mass server (1 or 2U server generally in a shelf) Each Blade server equipment (generally in a shelf) Each mainframe unit (both for rack or cabinet deployment)	Mainly indoor: Data centre, Server room Shelter	A or A3 (DC) or A1 (AC)	
ONT, modem, routers/switches, etc.			

The environment measurements (temperature, hygrometry) shall be done at the closest air inlet or/and on board.

The location of temperature sensors shall be justified by a precision measurement in factory test of the effect of different location (i.e. top, down, middle left, right) on a fully equipped system (rack or cabinet).

The identification reference of the ICT equipment defined by the operator in its database shall be associated with the power and cooling measurements to identify the equipment and its location.

The data shall be transmitted using the TMN monitoring protocol Recommendation to the ICT management system as defined in Recommendation ITU-T L.1395 [10] or the equivalent ETSI ES 202 336-1 [1]. If an ICT equipment includes a power/energy/environment parameters monitoring interface, it shall be compliant to ETSI ES 202 336-1 [1] and the present document for interoperability reason between ICT equipment or NMS and RMS Interoperability on the TMN is out of the scope of the present document.

4.4.2 External measurements type 2 (external sensors) for ICT equipment

The measurement type 2 of the ICT equipment (same list as in table 1) is done externally upstream from interface A by the following means:

- Current, Voltage sensors or Power or Energy Meters installed in electrical junction box or final power distribution frames or by sensors for current.
- Multi sensor Acquisition unit.
- A PEE DGU or CU.

NOTE: Sensors or meters can be interconnected to this CU or DGU, by a bus.

The monitoring interface at the level of the CU or DGU is ETSI ES 202 336-1 [1] with data information model of the present document.

Other environmental measurements (temperature, humidity) shall be associated in order to perform correlation with the power/energy measurements on the considered equipment. The temperature or humidity sensors have to be very close to the air inlet of this equipment, which means several measurements on a multicabinet system.

4.4.3 Common requirements for external (type 2) and internal (type 1) measurement

Requirements for measurement sensor are contained in ETSI ES 202 336-1 [1] in point 8.3.

4.5 PEE data analysis services

An operator can leverage services of analysis of Power/Energy/Environment data in addition to display and record. This can be Energy data analysis services which include various reports, with database management, and potential correlation services to understand the power consumption structure and optimization possibilities and progress.

NOTE 1: This kind of services can be done by a third party enterprise specialist of this kind of environmental analysis about any consumption, impacts, resources use in buildings and organizations such as any energy type use (electricity, liquid fuels and gas, etc.), water use, paper use, etc.

NOTE 2: The analysis services may refer to big data analytics and artificial intelligence technology, but this does not mean that this kind of smart services compensate the lack of accurate data acquired at relevant period on ICT equipment and network. This means that they can help to find interesting results and optimization in a more automatic and efficient way.

Figure 4 is showing what is in the scope and out of the scope of the present document.

The export of PEE data to the Remote Management System RMS, from NMS or OSS shall use data transmission and protocol defined in ETSI ES 202 336-1 [1] and data defined in the present document providing the information model.

NOTE 3: In the future, there could be also other data exchange protocol not yet specified to a third provider of power energy/energy analysis services common to many sites and many customers.

NOTE 4: One possible protocol could be based on 3GPP unified protocol under definition, see annex A in ETSI TS 132 101 [i.13].

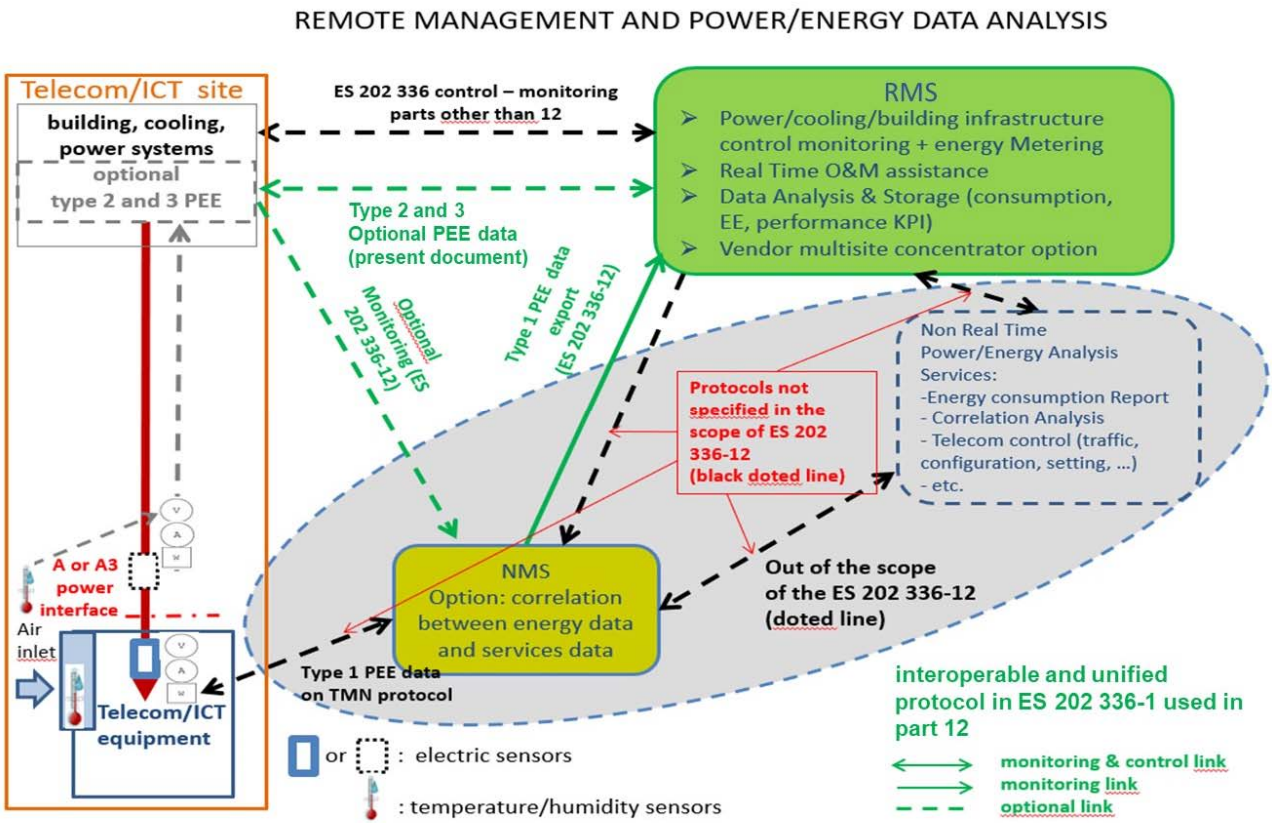


Figure 4: Limits of the scope of the standard about additional energy analysis services

Table A.1 (see annex A) corresponds to mandatory data that shall be provided for ICT equipment power/energy and environment monitoring model.

Table B.1 (see annex B) corresponds to non-mandatory data that shall be provided in addition to mandatory for ICT equipment power/energy and environment monitoring model.

Annex A (normative): Summary of mandatory monitoring / supervision information and functions

A.0 General description of mandatory monitoring / supervision information and functions tables

This annex defines the minimum set of information needed for the remote monitoring of power/energy and environment of ICT equipment.

NOTE 1: Table A.1 does not specify the equipment by itself. This table refer to subsets or devices that are not necessarily present in each equipment configuration. As a matter of fact, one alarm and its class apply only in case of the presence of this subset or device.

When an optional alarm that requires a parameter set is present, the corresponding parameter set is mandatory in the control section in order to allow remote adjustment under appropriate login procedure.

According to their types (Description, Alarm, Data, etc.), as defined in ETSI ES 202 336-1 [1] the information shall be provided by the Control Unit (CU).

NOTE 2: If there is no CU this data should be provided by the Data Gathering Unit (DGU).

When a CU has a field data bus connected to the DGU, at least, the DGU shall store data (record measurements, log files). The CU which has the interface over Ethernet TCP/IP shall store these data.

NOTE 3: The "Explanation" column provided in the data tables of annex A has been used where necessary to further explain the statements in the "Monitored information" column. The "Type" column gives the assigned name used in coding and the "Monitored information" column provides details of the condition or state being monitored. The identifiers used in the "Type" column of the tables of annex A are described in ETSI ES 202 336-1 [1].

NOTE 4: Partial communication network failures e.g. CU link fault should be detected by an upper element of the network e.g. the RMA (refer to figure 1 of ETSI ES 202 336-1 [1]).

NOTE 5: Clause 9.4.4 of ETSI ES 202 336-1 [1] details the parameters associated with elements e.g. time delay, severity of alarm element. The tables of annex A do not include the application of these parameters.

A.1 Table for ICT equipment power, energy and environmental parameters measurements

Table A.1

Type	Monitored information	Explanation
Description	Site and ICT equipment reference identification. The equipment is defined in table 1.	Site and ICT equipment mapping identification + Identification of measurement equipment Site identification is defined by each operator Equipment identification is defined by manufacturer in OSS in the element manager (see annex C)
	CU and measurement data issued configuration	High level description of equipment type (indoor, outdoor), measurement configurations (AC, DC, etc.)
Alarm	Sensors failure (current, voltage, temperature or power meter)	Additional detected failure can be too high noise, abnormal values, etc.
	Partial network failure (high error rate, CU or DGU link fault to the sensors, etc.)	This is the monitoring network that is considered
Event	Alarm set and clear (data log)	The start and end of alarm are recorded with time stamp in the datalog file of CU, DGU or of Network Equipment with embedded measurement
	Information of any configuration and/or parameters change	Idem
Data	Average active power	Value in W, accuracy and conditions are defined in ETSI ES 202 336-1 [1] in point 8.3
	Min active power	
	max active power	
	Active energy consumption over a period of time	Value in kWh for each input Sum of all inputs corresponding to one referenced equipment shall be provided Accuracy is defined in ETSI ES 202 336-1 [1] in point 8.3. It can be index of Energy since start of operation or just the energy consumed over T_{rec}
	Temperature of the equipment/ICT	Measure done at the level of fan tray when it exists Position to be justified by factory measurement on fully equipped equipment (see note)
	Time stamp of a set of measurements	
Data Record	Records of set of data defined in this table with time stamp at period T_{rec}	Frame of records transmitted at the transmission period T_{trans}

Type	Monitored information	Explanation
Config	Hardware configuration relevant to ICT equipment power consumption	Identification and description of power input at interface A. It can be at shelf level in a cabinet or rack mounted. Detailed power input configuration can be: Single, double, this should help to associate input corresponding to the same equipment consumption (A+B, A+B+C, etc.). This shall be available at remote management level to analyse data
	Complementary hardware information	E.g. telecom shelf system cabinet description for big Telecom sites
	Time-date setting (mandatory for any energy measurement) - not required if provided by NMS or EMS of the ICT equipment	yyyy/mm/day hh:mn:ss It is essential to have a precise time/date stamp to energy measurement for correlation to ICT configuration and status (traffic, settings, etc.)
	Alarm parameters setting	The setting threshold value for alarms e.g. for sensor failure detection
	Measurement parameters setting: energy, power, current record period	It is recommended to limit record time if fast acquisition to avoid excess of data amount
Control	For external CU alarm/event/test/command parameters (time-out, counter, thresholds, etc.) if any	It is required for internal measurement in the ICT equipment
	For external CU program download with default to previous release	Hexadecimal file It is required for internal measurement in the ICT equipment
NOTE: The room temperature measurement is already defined in ETSI ES 202 336-6 [8].		

Annex B (informative): Summary of non-mandatory monitoring / supervision information and functions

B.0 General description of non mandatory monitoring / supervision information and functions tables

According to their types (Description, Alarm, Data, etc.), as defined in ETSI ES 202 336-1 [1], the information should be provided by the Control Unit (CU) or by the Data Gathering Unit (DGU).

The non mandatory information of table B.1 are provided in addition to the mandatory information defined in table A.1.

NOTE: The "Explanation" column provided in the data table B.1 has been used where necessary to further explain the statements in the "Monitored information" column. The "Type" column gives the assigned name used in coding and the "Monitored information" column provides details of the condition or state being monitored. The identifiers used in the "Type" column of table B.1 are described in ETSI ES 202 336-1 [1].

Table B.1 gives a list of useful non mandatory information for ICT equipment power, energy and environmental parameters measurements.

B.1 Table for ICT equipment power, energy and environmental parameters

Table B.1

Type	Monitored information	Explanation
Description	Additive information	
Alarm	RMS current or active power consumption out of range after time-out	Above high threshold, it means overconsumption with respect to the maximum value specified by the manufactured for the defined equipment configuration. Below low threshold, it means probably a failure or incorrect settings of equipment. In both cases it can be also a measurement problem. The time-out can be used when required to filter fast current variation such as inrush current
	Temperature sensor measurement out of range	It would mean in, general sensor of measurement failure
	Too instable measurement - need an average or RMS filter	On new ICT equipment, power can vary too fast which can give large measurement error rate without appropriate data acquisition conditioner stage
	Power capacity management (ratio) = Used/Installed max power required	It needs maximum configuration active power consumption value to make this calculation
Event	Details of any change of configuration	

Type	Monitored information	Explanation
Data	RMS voltage on a power input at interface A or A3 (DC) or A1 (AC)	Value in V Accuracy is commonly ±1 % and independent of load. It is defined in ETSI ES 202 336-1 [1] in point 8.3
	RMS current on a power input at interface A or A3 (DC) or A1 (DC)	Value in A Accuracy is defined in clause 4.4.3 should ensure with power and energy measurement accuracies defined in ETSI ES 202 336-1 [1] in point 8.3
	Active power at board level	It can be useful for big telecom system. Accuracy as defined in ETSI ES 202 336-1 [1] in point 8.3. It can be data of several boards with appropriate identifier
	Temperature at the board level ±0,5 °C	It can be useful for big telecom system. Accuracy as defined in ETSI ES 202 336-1 [1] in point 8.3. It can be data of several boards with appropriate identifier
	Humidity	Measured at the equipment air inlet or at fan tray level when it exists (e.g. for ADSL). Accuracy 3 % The room humidity measurement is already defined in ETSI ES 202 336-6 [8]
Data Record	Local record with data of table A.1 and this table with time stamp at period T_{rec}	Frame of records transmitted at the transmission period T_{trans}
Config	Sliding time window to capture power consumption	Period of time over which power data logging is carried out
	All CU alarm/event/test/command parameters (time-out, counter, thresholds, etc.)	
Control	Parameters setting: alarm current, voltage, power, temperature thresholds (low, high)	
	Parameters setting: active energy counters	kWh
	Parameters setting: voltage loss time-out	hhmm

Annex C (informative): 3GPP NR Management reference model and generic management service definitions

3GPP has defined a Service Based Management Architecture (SBMA) framework for NR that provides Performance Management including reporting of Power, Energy, Environment conditions. Generic management service definitions for performance assurance management as well as provisioning management, fault supervision management, data reporting management and heartbeat management are specified in ETSI TS 128 532 [i.17].

Annex D (informative): Bibliography

ETSI TS 132 452: "Universal Mobile Telecommunications System (UMTS); LTE; Telecommunication management; Performance Management (PM); Performance measurements Home Node B (HNB) Subsystem (HNS) (3GPP TS 32.452)".

ETSI TS 132 453: "Universal Mobile Telecommunications System (UMTS); LTE; Telecommunication management; Performance Management (PM); Performance measurements Home enhanced Node B (HeNB) Subsystem (HeNS) (3GPP TS 32.453)".

ETSI TS 132 411: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Telecommunication management; Performance Management (PM) Integration Reference Point (IRP): Requirements (3GPP TS 32.411)".

ETSI TS 132 412: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Telecommunication management; Performance Management (PM) Integration Reference Point (IRP): Information Service (IS) (3GPP TS 32.412)".

ETSI TS 132 425: "LTE; Telecommunication management; Performance measurements (PM), Evolved Universal Terrestrial Radio Access Network (E-UTRAN) (3GPP TS 32.425)".

ISO/IEC 10164: "Information technology — Open Systems Interconnection — Systems Management: Objects and attributes for access control".

Annex E (informative): Change history

Date	Version	Information about changes
December 2024	V1.3.1	removed accuracy and sensor description as moved to part 1, delete reference to XML

History

Document history		
V1.1.1	June 2015	Publication
V1.2.1	February 2019	Publication
V1.3.1	July 2025	Membership Approval Procedure MV 20250907: 2025-07-09 to 2025-09-08